

Fifth Annual Conference on Carbon Capture & Sequestration

Steps Toward Deployment

Technical Session: Policy

***Will Maturing GHG Markets Make IGCC the Coal
Technology of Choice?***

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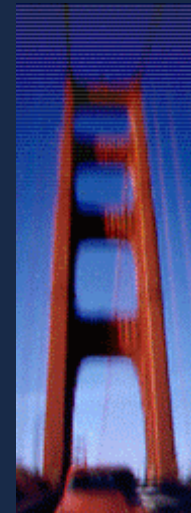
Trexler Climate + Energy Services



May 8-11, 2006 • Hilton Alexandria Mark Center • Alexandria, Virginia

Company Profile, Nexant, Inc.

- Formed on January 1, 2000, core group from energy consulting and advanced energy technology units of Bechtel
- Headquartered in San Francisco, with other major offices in London, New York, Bangkok, and Denver
- Prime Focus Areas:
 - Advanced power technologies
 - Renewable energy
 - Environmental economics
 - Energy efficiency and demand-side management
 - Global petroleum, natural gas, and chemical forecasting



Company Profile, TC+ES

- Formed in 1991, specializes in climate change consulting to the private sector. Principals have extensive energy policy and facility siting experience, including with IGCC.
- A major focus since 2000 has been GHG market price forecasting for Japanese and Canadian clients. TC+ES models and tools help companies understand and forecast GHG markets, whether to 2012 or 2040.

TC+ES

TREXLER CLIMATE + ENERGY SERVICES

- Prime focus areas:
 - Corporate GHG risk management
 - Emissions trading system design
 - Mitigation project and portfolio analysis and development

Presentation Overview

SECTION 1

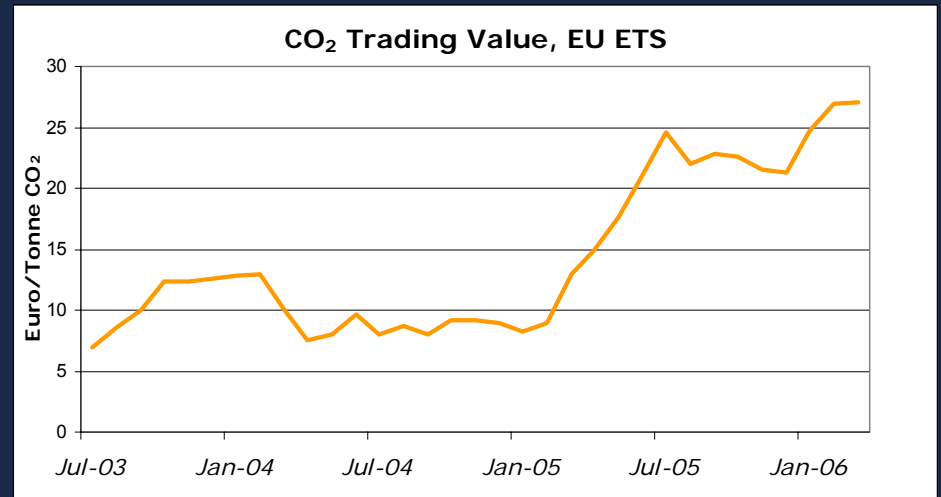
- 1. Role of Carbon Credit Markets**
- 2. Possible Scenarios for Future Carbon Values**

SECTION 2

- 3. State of Fossil Power Generation Technology**
- 4. Impact of Carbon Scenarios on New Coal Plant Selection**

The Role of Credit Markets

- International mitigation options likely to drive credit prices
 - Cost savings from trading simply too great to ignore
- CO₂ markets still nascent
 - \$2-10/ton in U.S. voluntary market (since 1989)
 - ~\$35/ton in today's EU ETS market (since 2003)



But What About the Longer Term View?

Carbon Credit Price Forecasting

■ While a Supply and Demand Approach Makes Sense...

- Demand is (obviously) largely a function of policy decisions
- But (much less obviously) so is supply
 - What is a “credit”?
 - How are “credits” quantified?

■ This Makes the GHG Commodity a Very Different One

- Price forecasts are almost meaningless outside of the accompanying policy context

Scenarios Considered—Simplifying the Future

■ Potential Scenarios:

1. Issue Collapse (Low Impact)

- Major political and economic challenges prevent change
- **Likelihood: Low—Broad scientific and public support**



2. Incremental Change (Medium Impact)

- Some policy efforts made, but no atmospheric stabilization
- **Likelihood: High—Reflects implementation challenges of issue**



3. Atmospheric Stabilization (High Impact)

- Political will developed to tackle climate change
- **Likelihood: Low—Level of cooperation almost unprecedented**



Model Used: The Cli-Mit Market Analyzer ©



*Incorporating the complexity of the GHG market,
while offering easy access to market outcomes*

Model Variables

Supply Variables

- The annual rate at which projects can be validated
- The stringency of additionality rules
- When methodologies are approved for different sectors
- What regions of the world supply can come from
- When host countries are ready to approve projects
- Sector-specific technical and practical potentials, based on the latest studies and expert insight
- Sector-specific deployment rates, based on expert insight
- Sector-specific economic analysis

Demand Variables

- Global Emissions Growth
- Stringency of the EU ETS
- Whether, When, and the Severity Future Targets Are Set
- United States Participation
- How Much Hot Air Will Come Into the Market
- The Proportion of Demand Met Through Credits

Scenario Outcomes

	2005-2010	2011-2016	2017-2020
<i>Incremental Change</i>	\$4-6/ton	\$5-15/ton	\$10-30/ton
<i>Stabilization</i>	\$7-15/ton	\$15-25/ton	\$25-40/ton
<i>Issue Collapse</i>	\$4-6/ton	\$4-6/ton	\$4-6/ton

Note: These are not “upper end” scenario prices, but are relatively conservative given model inputs. Potential for upside.

Which Scenario Best For IGCC/SCPC Analysis?

Dependent on...

For the IGCC/SCPC decision:

- What is a company's economic exposure to future GHG cases?  **HIGH**
- Can shifts in policy and market trends be anticipated?  **DIFFICULT, BUT MANAGABLE**
- What timeframe needs to be considered?  **LONG-TERM (~30-40 years)**

For this analysis, “Incremental Change” considered most likely, but utilities may want to hedge “Aggressive”

Can't EU ETS Markets Be Extrapolated?

- Very unlikely due to the changing commodity market
- **Post-2008 market changes include:**
 - Non-CO₂ sources of reductions becoming available
 - CDM credit supply increasing dramatically
 - Russia/Ukraine “hot air” entering market
 - JI projects allowed
- **Futures market in CO₂ reflects oversupply**



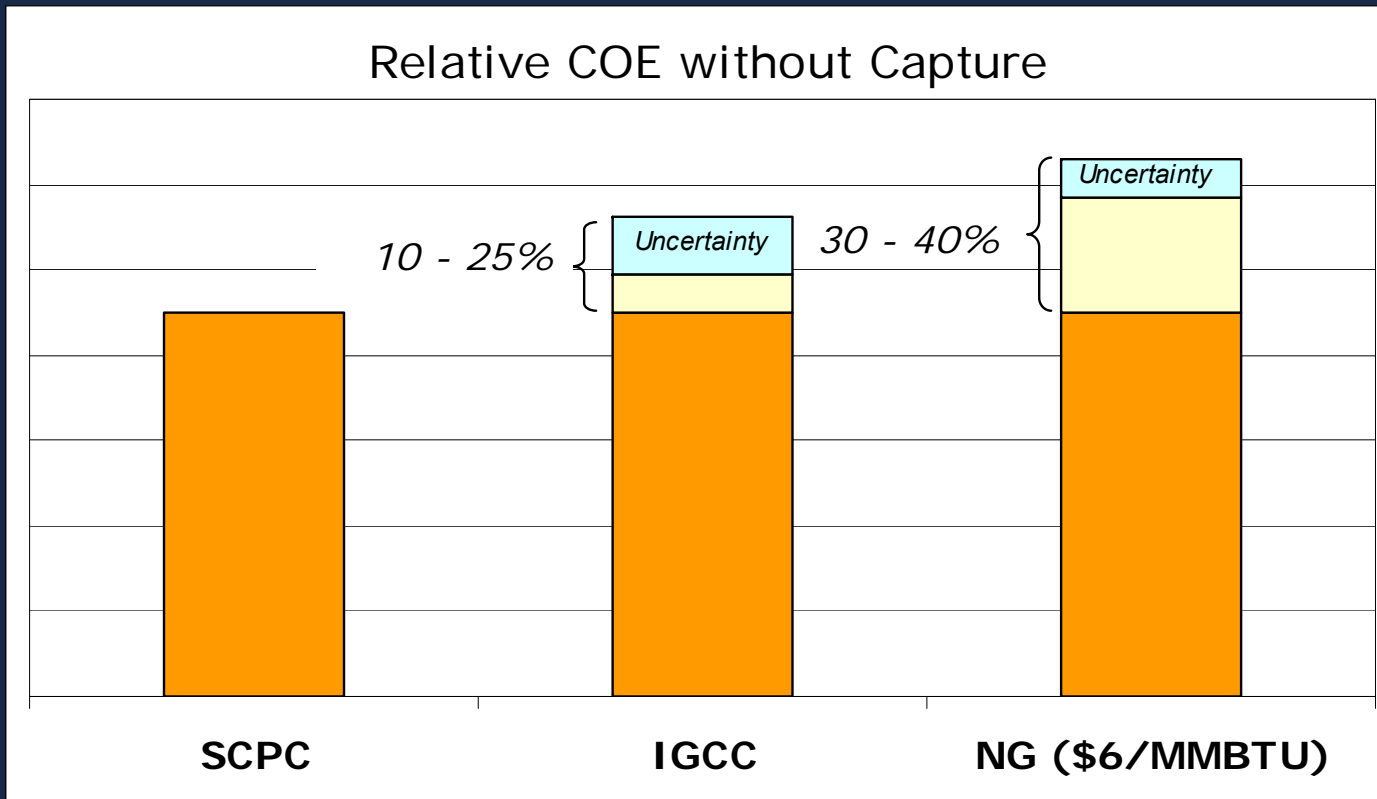
SECTION 2

Maturing CO₂ Markets and the PC vs. IGCC Decision

“Indecision is like a stepchild: if he does not wash his hands, he is called dirty, if he does, he is wasting water. “

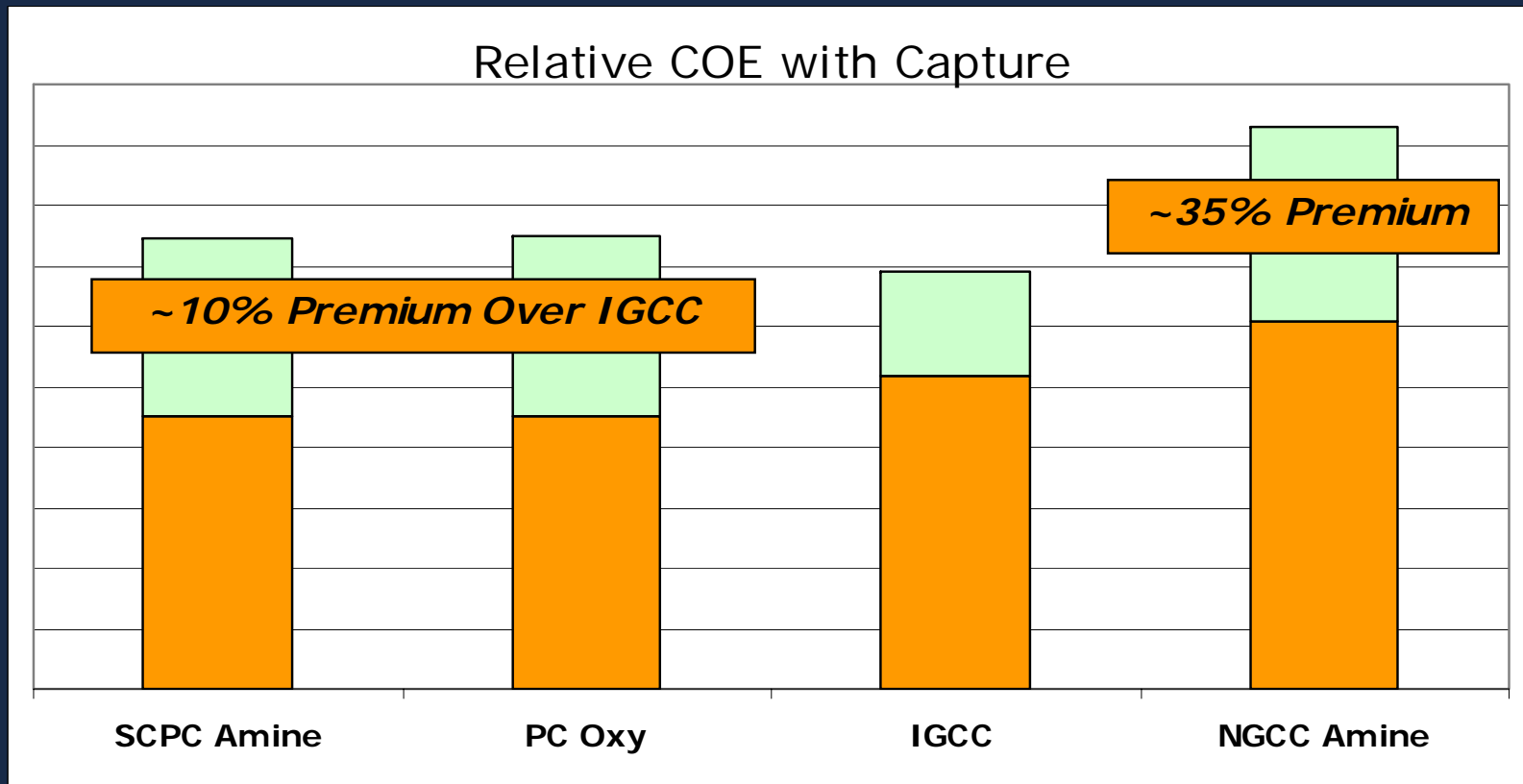
--African Proverb

State of Fossil Power Generation Technologies



Nexant analysis, plus 12 literature sources (2003 to 2006)
New Plants, Bituminous coal, 500-800 MW plants

State of Technologies, with CO₂ Capture



Current technology favors IGCC if capture required

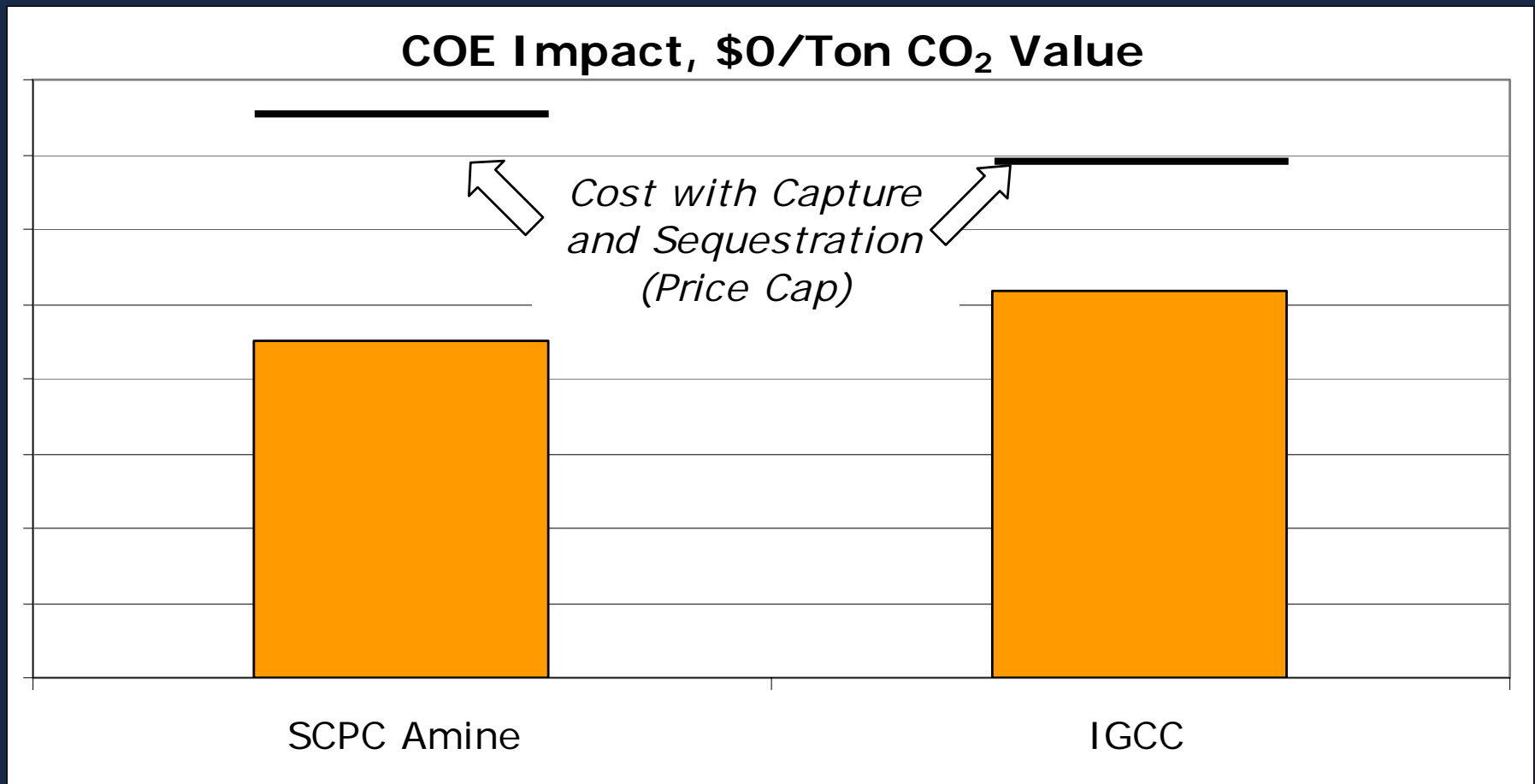
SCPC vs. IGCC Analysis

■ **GOAL:** Determine what CO₂ price necessary to provide sufficient incentives for IGCC adoption in new coal plant construction

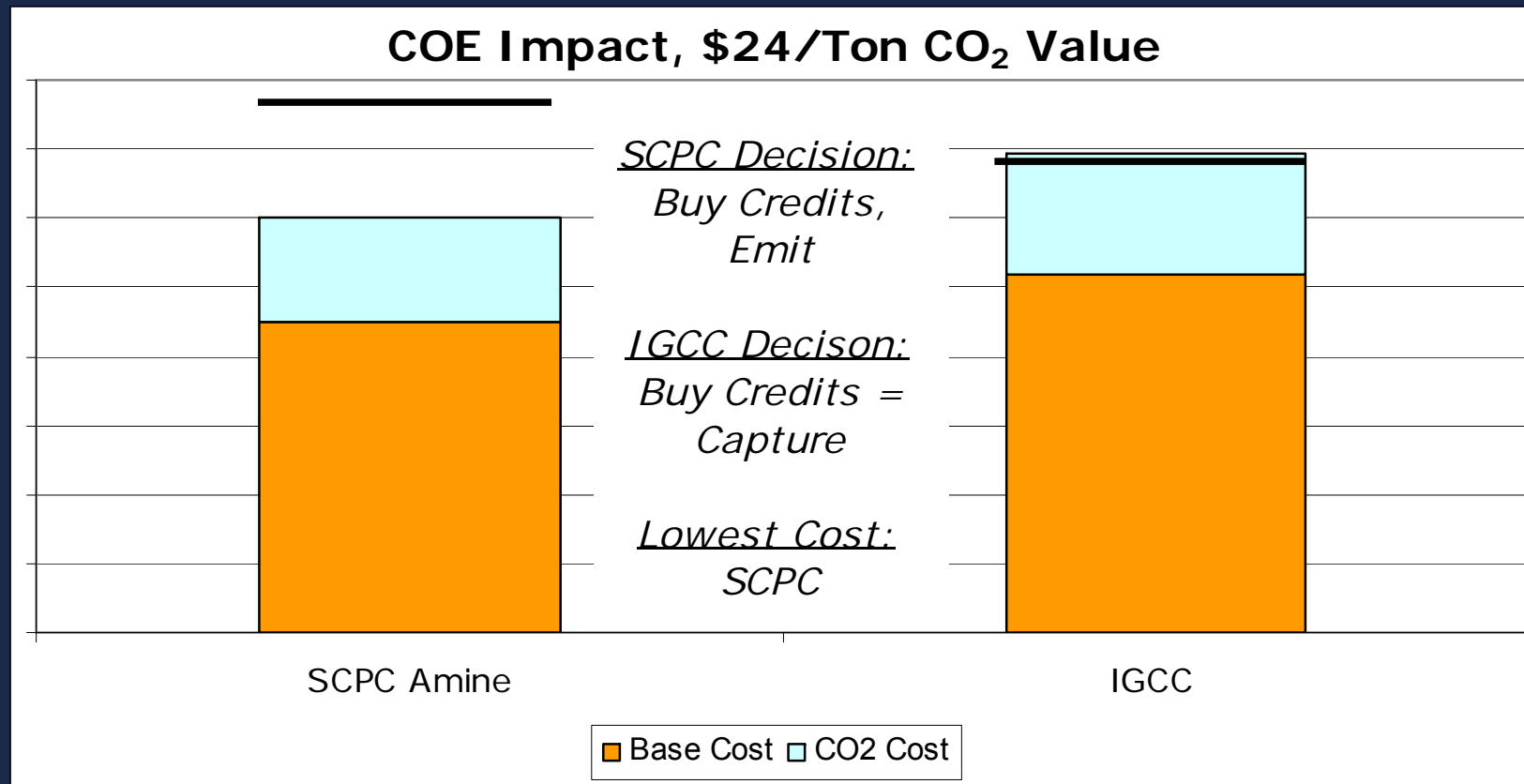
■ **Assumptions**

- CO₂ value ONLY is driving technology and capture decisions
 - No capture mandates
 - No technology subsidies
- No partial capture (either capture or emit)
- Sufficient credits available for purchase at market clearing price
- Price shown is international marginal value

You Be The Decision Maker, \$0/Ton CO₂ Value

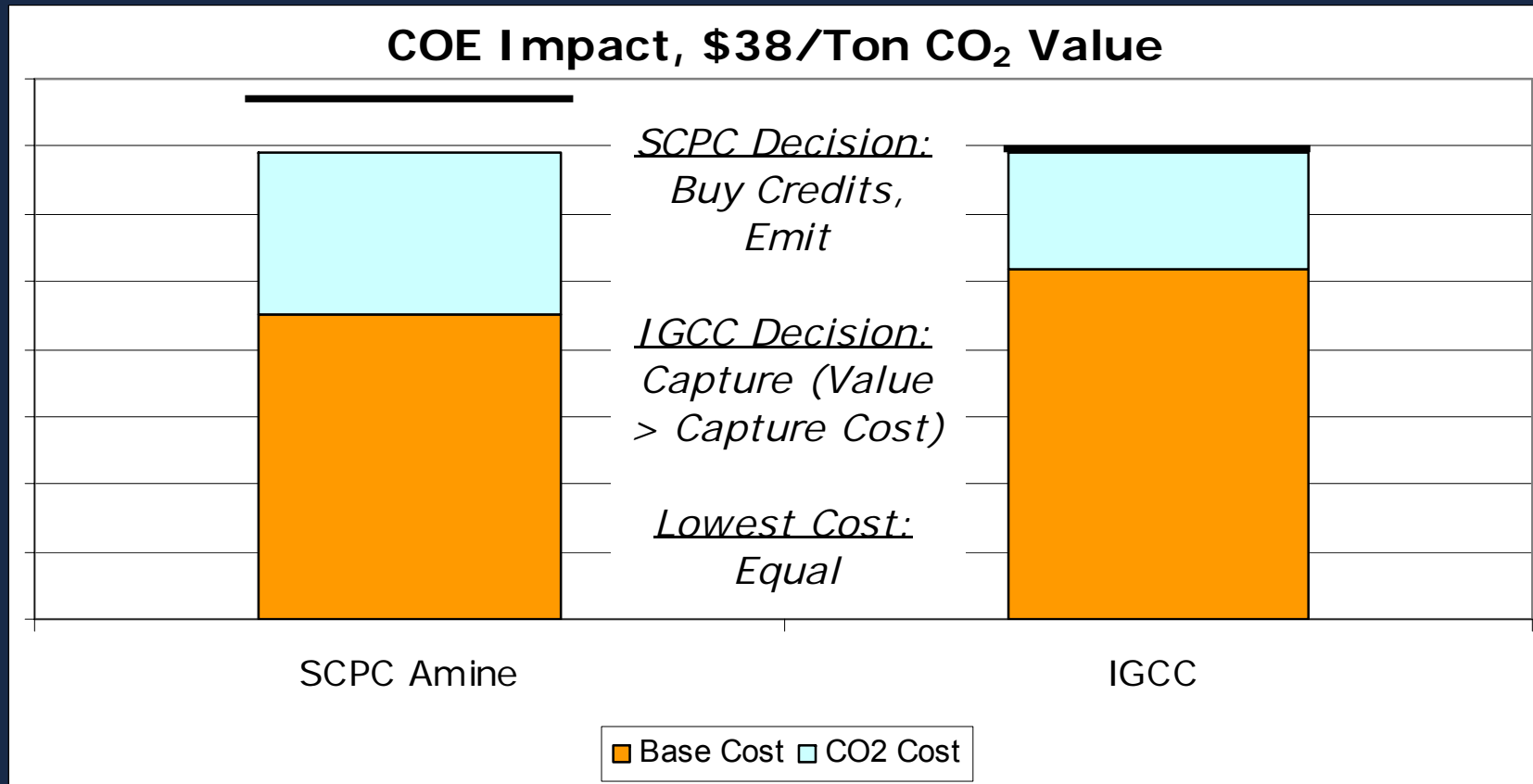


Decision Change at the Breakeven IGCC Capture Value?



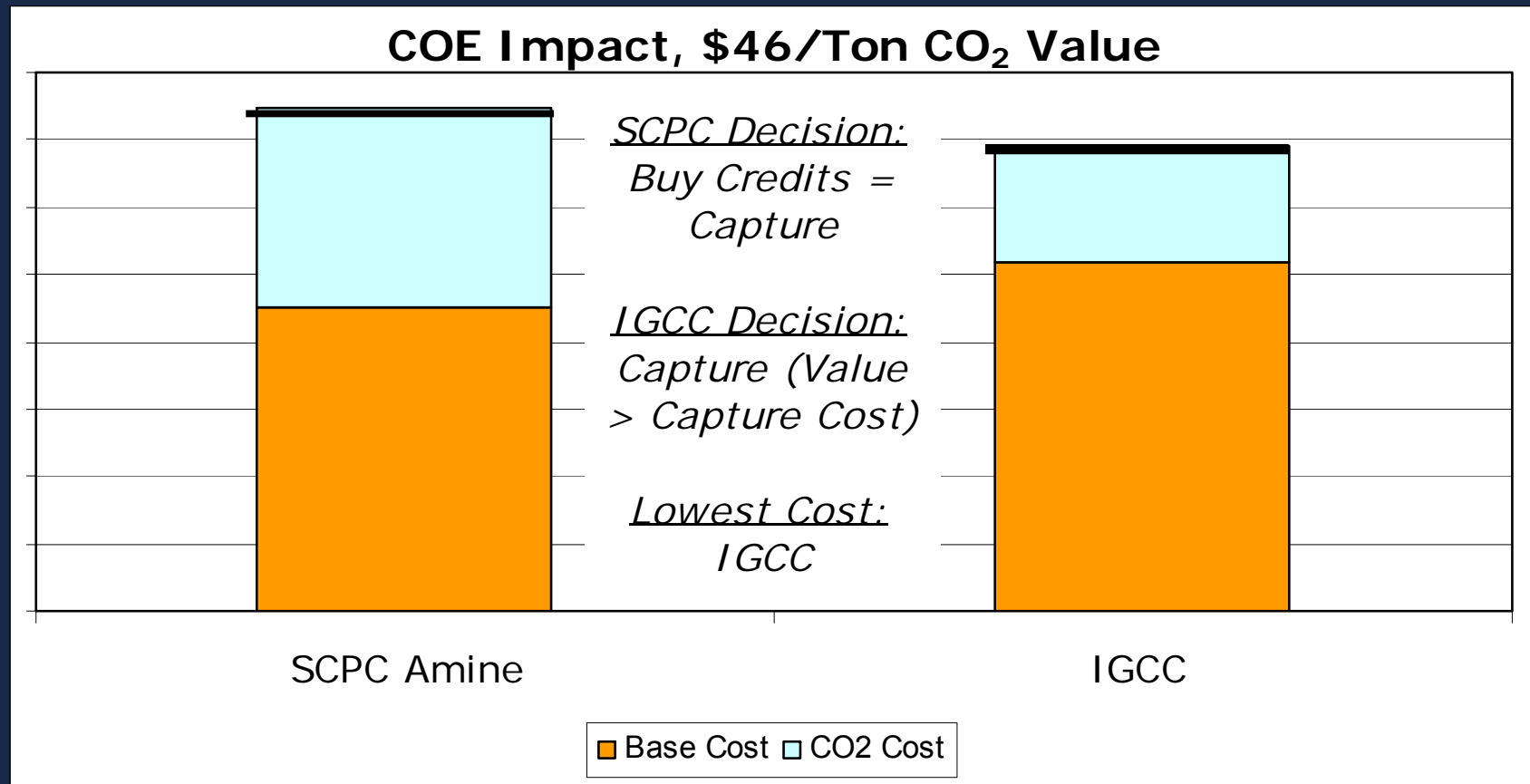
IGCC plants now likely to capture, BUT...
provided sufficient credits exist, SCPC without capture less costly

SCPC vs. Amine Breakeven



IGCC plant capture cost (\$24/ton) caps impact due to CO₂

When Will SCPC Plants Capture CO₂?



If required to capture, IGCC provides lowest COE

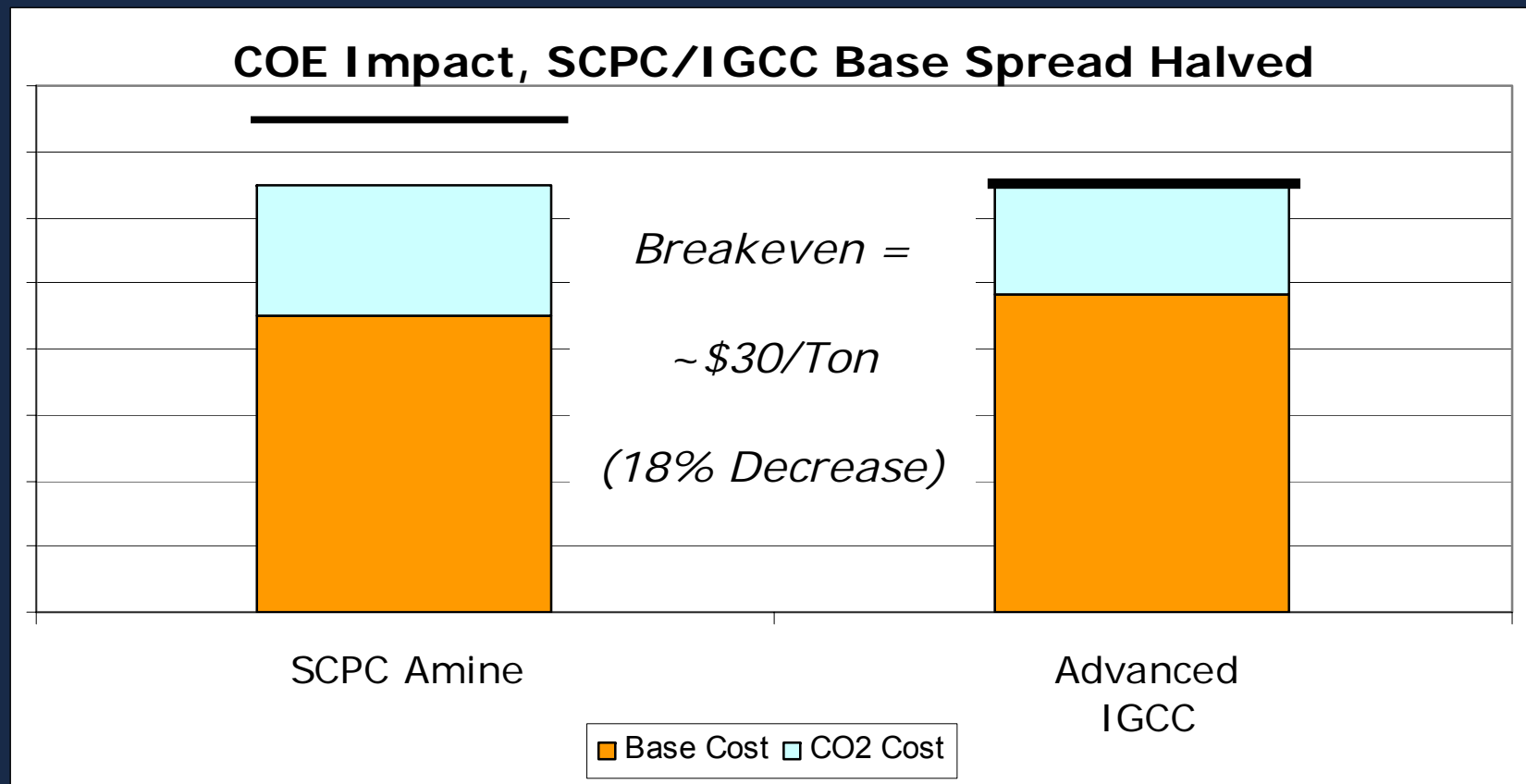
Sensitivity Analysis

Key Technology Sensitivity: IGCC Base Plant Premium

What if IGCC/SCPC base plant COE gap cut in half?

- Assumes advances in technology
 - Gasifier (reliability)
 - Power block (novel, such as CES)
 - Syngas clean-up (raises efficiency)

Sensitivity 1: Reduction in Base Plant IGCC Cost



***Provided base plant IGCC has some premium:
Breakeven Value = IGCC Premium + IGCC Capture
Cost***

Will CO₂ Markets Alone Support IGCC Decisions?

Case	2020 Estimate, CO ₂ Value	CO ₂ Driver for IGCC and Capture	Promote IGCC?
Incremental Change	\$10-30	~\$38	Unlikely in this timeframe
Aggressive Policy	\$25-40	~\$38	Likely with future upside

With a 30 to 40 year power plant life, proper timeframe **2010-2045**

- MUST make long-term estimate, determine cost and exposure to risk
- MUST take into account other policy drivers
 - If capture required, IGCC currently has advantages over SCPC Amine
- MUST take into account other environmental drivers (Hg, water use)
- MUST estimate technological advancement potential

Additional Study Areas

- 1. Enhanced Meta Analysis, or Case-Specific Analysis, for SCPC/IGCC spread**
 - Increased accuracy on breakeven point
 - Incorporate other environmental drivers and factors
- 2. Full power plant life model estimates**
 - Extended through 2040-2050 timeframe
 - Evaluate costs/risk throughout plant life
- 3. Company-customized GHG credit price modeling, promoting cross-company buy-in to a scenario(s)**

For More Information

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